CLAIMS

1. A bottom-to-surface connection device comprising at least one undersea pipe or riser (1, 1a-1b) including at least one float and possibly including only one float (2, 2_1-2_7), said float being connected at its bottom end to a junction device (8) creating a leaktight flexible joint between the bottom end of the float (2) and said riser (1a), the connection device being characterized in that said junction device (8) is interposed between and secured to a bottom portion (1a) of the riser going down to the sea bottom and a top portion (1b) of the riser passing through said float and rising to the surface, said junction device (8) comprising at least:

- a first forged body of revolution (22) secured to the top end of said bottom portion (1a) of the riser, and forming an internal tubular duct section (22_3) having substantially the same diameter as said bottom portion of the riser; and

- a second forged body of revolution (24) secured to the bottom end of said top portion (1b) of the riser, and forming an internal tubular duct section (24_4) having substantially the same diameter as said top portion (1b) of the riser;

- said first and second forged bodies (22, 24) being interconnected in flexible and leaktight manner by at least a first flange (23) in the form of a body of revolution secured in leaktight and reversible manner to said second forged body (24) and connected to said first forged body (22) by at least a first laminated abutment (30) in the form of a body of revolution, comprising a plurality of elastomer layers interposed between rigid reinforcements preferably made of metal defining surfaces of revolution having the same axis as the common longitudinal axis of revolution ZZ' of said first and second forged bodies (22, 24) and said first flange (23, 23a-23b), said surfaces of revolution being frustoconical in shape or skew surfaces, such as surfaces of sections

that are ellipsoidal or parabolic or hyperbolic or preferably spherical in shape.

2. A bottom-to-surface connection device according to claim 1, comprising an undersea pipe or riser (1, 1a-1b) tensioned by at least one float (2, 2_1, 2_7) constituted by a can presenting a cylindrical casing (20) surrounding said pipe (1b) coaxially, located on the high underwater portion of said pipe (1, 1a-1b), said pipe (1, 1a, 1b) preferably being held and guided by a surface guide device (4, 6) located at a floating support (10) and including a said junction device (8) for said can (20), the connection device being characterized in that:

- said first forged body (22) presents in its top portion an outer first surface of revolution (22_1) that is preferably frustoconical in shape or of ellipsoidal section; and

- said second forged body of revolution (24) secured to the bottom end of said top portion (1b) of the riser, preferably by welding (24a), presents in its bottom portion a bottom first surface (24_1); and

- said first flange (23, 23a-23b) presents:

  • an inner first surface of revolution (23_1) of frustoconical shape or of ellipsoidal section, said inner first surface (23_1) of the first flange (23, 23a-23b) and said outer first surface (22_1) of the first forged body (22) being situated facing each other and co-operating elastically and in leaktight manner via a said first laminated abutment (30) in the form of a body of revolution that is frustoconical in shape or respectively of ellipsoidal section, comprising a plurality of layers of elastomer sandwiched between reinforcing sheets of rigid material, in particular steel sheets, bonded to said inner first surface (23_1) and said outer first surface (22_1) thus bonding together said first flange (23, 23a-23b) and said first forged body (22); and

• at least a portion of a top surface (23_2) of said first flange (23, 23a-23b) co-operating in leaktight manner, preferably via at least one O-ring (28), with said bottom surface (24_1) of said second forged body of revolution (24), said top surface portion (23_2) of said first flange (23, 23a-23b) and said top surface (24_1) of said second forged body (24) being secured to each other in leaktight and reversible manner, preferably by bolting (27); and

- said outer casing (20) of the float (2) being secured to a top surface (24_2) of said second forged body (24) or to a top surface (21_1) of a second flange (21) in the form of a body of revolution having a bottom surface (21_2), itself bonded in leaktight and reversible manner, preferably by bolting (25) and via at least one O-ring (26), to a portion of said top surface of revolution (23_2) of said first flange (23, 23a-23b).

3. A device according to claim 1 or claim 2, characterized in that said second forged body of revolution (24) includes in its bottom portion an outer second surface (24_3) of frustoconical shape or preferably of ellipsoidal section, and said outer second surface of revolution (24_3) is situated facing and co-operates elastically and in leaktight manner with an inner second surface of revolution (22_2) of frustoconical shape or respectively of ellipsoidal section, said inner second surface (22_2) being situated in the top portion of said second forged body (22), and said inner second surface (22_2) being connected to said outer second surface (24_3) via a second laminated abutment (31) in the form of a body of revolution constituted by a plurality of elastomer layers sandwiched between rigid reinforcing sheets, in particular of steel, that are frustoconical in shape or respectively of ellipsoidal section, and that are bonded to said outer second surface (24_3) and to said inner second surface (22_2).

4. A device according to claim 2 or claim 3, characterized in that said first abutment (30) and where appropriate said second abutment (31), said outer first surface (22_1) of the first forged body (22), said inner first surface (23_1) of the first flange (23, 23a-23b), and, where appropriate said outer second surface of revolution (24_3) of the second forged body (24), and said inner second surface of revolution (22_2) of the first forged body (22) are all frustoconical in shape about the same said axis of revolution ZZ', with an angle of the apex β lying in the range 30° to 80°, preferably in the range 40° to 70°, the apexes of the various frustoconical surfaces being situated below said frustoconical surfaces, and the various frustoconical surfaces either sharing a common angle at the apex β or a common apex C.

5. A device according to any one of claims 1 to 3, characterized in that said first abutment (30), and, where appropriate said second abutment (31), said outer first surface (22_1) of the first forged body (22), said inner first surface (23_1) of the first flange (23, 23a-23b), and, where appropriate said outer second surface of revolution (24_3) of the second forged body (24), and said inner second surface of revolution (22_2) of the first forged body (22) are all of ellipsoidal section, preferably of spherical section, all being substantially centered on the common point O situated above said surfaces and on said axis of revolution ZZ'.

6. A device according to any one of claims 1 to 5, characterized in that said first and second forged bodies (22, 24) and said first flange (23, 23a-23b) define a first internal chamber (40) which preferably co-operates with pressure sensor means (41, 42) for monitoring the pressure inside said chamber (40).

7. A device according to claim 6, characterized in that said first chamber (40) is defined by the top portion of said first forged body (22) and by the free portions of said bottom surface of revolution (24_1) of said second forged body (24), said concave inner first surface of revolution (23_1) of said first flange (23, 23a-23b), and said convex outer second surface of revolution (24_3) of said second forged body (24).

8. A device according to any one of claims 2 to 7, characterized in that said outer casing (20) of the float (2) is secured to an internal second pipe (3) of greater diameter than said riser (1, 1b), said internal second pipe (3) preferably being a reinforced pipe of thickness greater than said riser (1), and in that it includes a said second flange (21) in the form of a body of revolution to which the bottom end of said outer casing (20) of the float (2) and the bottom end of said internal second pipe (3) are secured, preferably by welding (21a, 21b), said second flange (21) surrounding said second forged body (24) so that a second inner chamber (45) is defined by an inner surface of revolution (21_3) of said second flange (21) having the same axis of revolution ZZ', by said top surface of revolution (24_2) of said second forged body (24), by the cylindrical outer surface (1_1) of said top portion (1b) of the riser and the cylindrical inside surface (3_1) of said internal second pipe (3), and by a closure flange (5) at the top ends of said internal second pipe (3) and of said top portion (1b) of the riser, said second chamber (45) preferably co-operating with means for monitoring the pressure (47, 48) inside said second chamber (45).

9. A device according to any one of claims 2 to 8, characterized in that said top surface peripheral (23_2) of the first flange (23, 23a-23b) and said bottom surface (24_1) of the second forged body (24), and where

appropriate said bottom surface (21_2) of said second flange (21), are annular plane surfaces.

10. A device according to claim 8 or claim 9, characterized in that said internal second pipe (3) extends above said float (2), preferably in the form of a reinforced pipe of thickness greater than said riser (1) which it surrounds, and preferably a holding and guide device (4, 6) serves to guide said internal second pipe (3) relative to said floating support (10).

11. A device according to any one of claims 1 to 10, characterized in that the top end of the float (2) is secured to the top portion (1b) of the riser (1) or of said internal second pipe (3) via a rigid junction (8_1).

12. A device according to any one of claims 1 to 11, characterized in that said float (2) is a single float extending over a length of 40 m to 100 m in order to confer buoyancy enabling the entire bottom-to-surface connection to be tensioned, said float (2) preferably being made up of segments that are assembled to one another, each being constituted by a cylindrical box, which boxes are preferably individually sealed (2_1, 2_7), and secured mechanically to one another in the longitudinal direction ZZ'.

13. A device according to any one of claims 1 to 11, characterized in that the buoyancy of said undersea pipe (1) is provided by said float without adding any additional tensioning system that is secured to the floating support (10).

14. A device according to any one of claims 1 to 13, characterized in that it includes stabilizer means (60, 61) in the bottom portion (2_7) of the float (2) having the effect of increasing the mass of water it entrains when

it moves, or lowering the center of gravity of the top portion of the pipe in the float (2).

15. A device according to claim 14, characterized in that a stabilizer means comprise a helical ramp (61) surrounding the bottom portion (2_7) of said float (2) close to its bottom end.

16. A device according to claim 14, characterized in that a stabilizer means comprises an additional peripheral mass (60) situated around the bottom portion (2_7) of the float (2).

17. A device according to any preceding claim, characterized in that said first flange (23) comprises two portions (23a-23b) in which the first portion (23a) is a body of revolution including said inner first surface (23_1), and said second portion (23b) is a peripheral flange including said top surface (23_2), said second portion (23b) being secured in leaktight and reversible manner to said first portion (23a) via at least one O-ring (29) by securing in leaktight and reversible manner said top surface peripheral (23_2) of the first flange (23) to said bottom surface (24_1) of said forged second body (24).